GENERAL INFORMATION

REPORT ON AUCKLAND EARTHQUAKE ENGINEERING SEMINAR

The Seminar was held at the School of Engineering on 19, 20, 21 June, 1978, "..... to present to practicing engineers some recent developments in the rapidly changing field of earthquake engineering". Papers were mostly presented by staff of the University and topics included experimental research on cyclic loading of beams, structural analysis, design of the ANZ building in Wellington, and assessment of earthquake resistance of existing buildings. The convenor was Associate Professor R. Shepherd and the Seminar, which was well run with very satisfactory catering arrangements, was attended by about 60 engineers mainly from the Auckland area.

Engineers have difficulty in finding time to keep up with technical developments in their field among the more pressing demands of "getting jobs out". At meetings of this nature participants can find out what others are doing and thinking, and can spend some time in an academic environment considering technical aspects of their work. In this respect the seminar and the presence of the various speakers was of great value.

Mr. Glogau opened the conference as President of the Society and contributed a paper, and valuable comments as Chief Structural Engineer MWD. Dr. Skinner contributed as usual in the area of earthquake dynamics, as well as from his impressions of the 1977 Bucharest earthquake. The papers on various aspects of structural analysis and design for earthquake illustrated clearly the advances being made, and provided further insights into the changes made to the loadings code. Max Irvine, unfortunately since departed for the U.S., presented a thought provoking paper on torsion in buildings, and, a remarkable achievement, presented advanced concepts in dynamic analysis in terms familiar to his audience. The gap between the practicing engineer's understanding of dynamic analysis and that required in the current university curriculum is considerable, is difficult to bridge, and is an area in need of continuing education.

Professor Taylor closed with a plea for re-consideration of the recently published concept of a "seismic design committee". Judging by the health of the Society, and the general level of awareness and expertise in earthquake engineering indicated by attendance at the Seminar and similar conferences, there would appear to be no need for another body to review the level of competence displayed by engineers in their professional work.

Roger Brown

EARTHQUAKE RISK BUILDINGS IN WELLINGTON

(A report on recent developments in Wellington with some concluding observations on Section 301A of the Municipal Corporations Act.)

In late August of this year the Wellington City Council advised that in 1983 owners of earthquake risk buildings in the main retail areas of the city would be served formal notices for demolition or strengthing and that the maximum time permitted for complying with the notices would be five years. The action was generally considered to be a relaxation of Council policy. This article examines the background to the present situation.

In 1972 the Council established a policy that earthquake risk buildings in the main retail areas (Lambton Quay, Lower Willis Street, Manners Street, Cuba Street and Courtenay Place) should be either demolished or strengthened to two-thirds of the level of the current code requirements by the year 1982 and that earthquake risk buildings in other areas should be similarly treated by the year 2000. The recommendation made in 1972 called for a policy emphasising encouragement rather than enforcement.

A survey undertaken by the Council identified 183 earthquake risk buildings in the main retail areas and a further 575 in the commercial areas. These buildings comprise a little less than 50% of the pre-1935 building in the city. Thus there are many buildings which are not classified as earthquake risks, but which were designed before the adoption of seismic design provisions in 1935.

The owners of earthquake risk buildings in the main retail areas were notified in 1973 of the Council's findings in respect of their buildings and of the Council's powers in terms of Section 301A of the Municipal Corporations Act. They were also advised that they would not be permitted to make major alterations to their buildings without strengthening them and that at some time in the future Council would require the demolition or strengthening of their buildings. They were not given a time limit at that stage.

Owners of earthquake risk buildings who have sought advice as to when the Council may enforce demolition, have been advised that for buildings in the main retail areas and special buildings such as cinemas, theatres, hotels, hostels, hospitals, schools, etc. a life of more than 10 years should not be anticipated. For other earthquake risk buildings an

approximate life of 15 years could be anticipated and possibly more depending on the location, occupation and condition of the building.

Progress in replacing or strengthening buildings has been slow. Of the 183 earthquake risk buildings in the main retail areas of the city only 19 have been demolished and 2 strengthened since 1973 - leaving 162 (which occupy about 40% of the street frontage of the area).

The situation recently came to a head when the Challenge Corporation decided, apparently for economic reasons, to postpone development of a site on Lambton Quay. The Council was asked to extend the life of the (designated earthquake risk) buildings on the site and to allow refurbishing and the construction of a shopping mall - without the strengthening normally required by the Council. The removal of parapets and bolting of brick walls to timber floors was, however, proposed.

The city buildings engineer argued that:

1. If the Challenge Corporation is refused permission to temporarily refurbish its premises, the buildings will probably remain in their present state as regards earthquake risks until either the Challenge Corporation is in a position to redevelop the site or compulsory demolition is enforced.

2. If compulsory demolition is enforced prior to the date when redevelopment is possible another vacant site will result which would be contrary to the spirit of the Council policy established last year in respect of such vacant sites.

3. The movement and removal of earthquake risk buildings has been slow in the past five years. The "encouragement policy" adopted by Council in 1972 has been frustrated by the economic climate. The 10 years period recommended by the City Engineer in 1972, may now be unrealistic.

4. If the current trend continues it appears that in 1982 at least 75% of the earthquake risk buildings in the main retail areas will still be in existence. At that stage, even if redevelopment is economically feasible, it is unlikely that the Government's usual economic stabilization measures would permit the Building Programmer to give approval for the erection of approximately 140 buildings in a short space of time. It appears that some extension of time will have to be given.

5. The Challenge Corporation is prepared now to marginally improve the earthquake resistance of its buildings on the understanding that compulsory demolition is not enforced before 1988. This partial strengthening is a secondary issue, the main issue being the 6 year extension in the life of the building.

Council endorsed (but not unanimously) this viewpoint and agreed to extend the life of the building provided that both the programme of partial strengthening was carried out and provided an undertaking to demolish or strengthing the buildings by 1988 was given. Subsequently all the 162 earthquake risk buildings in the main retail areas were given an extension of life of up to 5 years. The date for removal or strengthening of the earthquake risk buildings outside of the main retail areas has not been altered. A greater number of these buildings have been demolished in the course of normal development, though no numbers are available.

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It is hard to believe that this is the last word on earthquake risk buildings in Wellington.

In the present economic climate owners of earthquake risk buildings may not find it easy to finance strengthening, or demolition and replacement, and furthermore they are unlikely to perceive that redevelopment is a viable financial proposition in the longer term. It is not inconceivable that limited Government assistance (e.g. easy term finance) may be needed to implement the policy. The sums involved appear to be vast. The 183 buildings in Wellington probably involve about 3 million square feet[1] and if a majority are to be demolished and replaced (as appears to be the trend) the total cost may be about $100 to $200 million at present day prices. If all earthquake risk buildings in Wellington are included the cost is many times this amount (note that this applies to Wellington only).

Even if this programme of work was completed there would remain many other buildings whose post-elastic behaviour in earthquakes may be poor and for which the consequences of failure in terms of life loss may be serious. The reason for this is that the Act applies only to buildings constructed of unreinforced concrete or unreinforced masonry which have an ultimate lateral strength less than one-half that specified in NZS 1900, Chapter 8, 1965. Thus the Act directs substantial resources into mitigating the hazards from one class of 'earthquake risk' buildings only.

In Wellington, minimum strengthening of an earthquake risk building involves increasing the lateral resistance to 2/3 that specified in Chapter 8, 1965. If the cost of this strengthening is high then owners will be encouraged to demolish and replace their buildings. If this occurs then I suggest that the policy is too stringent and that it is unwittingly incurring a significant net cost to the community.

The aim of the strengthening policy is to increase the safety of the occupants and should therefore be directed towards improving the post-elastic behaviour of earthquake risk buildings. Lateral strength is obviously desirable, but there are other ways of increasing safety (for example, provision of independent floor supports) which could be much less costly and which could form part of a more efficient strengthening package.

For these reasons I suspect that present policies towards earthquake risk buildings are leading to an inefficient use of considerable resources. What is

required is a comprehensive assessment of the likely costs and benefits from present policies, and if possible alternatives. Such an analysis would give an indication of how much to spend on mitigating the earthquake hazard from older buildings, and how best to spend it.

(Thanks to Ken Mulholland for information on WCC policy.)

REFERENCE

1. Paper G, Seminar on High Earthquake Risk Buildings, Wellington, 1973. Paper delivered by Sir Francis Kitts.

R. J. Bentley

MAY 1979 CONFERENCE

Accepted abstracts for the South Pacific Regional Conference on Earthquake Engineering (May 8-10, 1979, Wellington) are listed below. Papers will be subject to final review before acceptance.

Ohaski, Iwasaki, Tatsuoka and Tokida, "A Simplified Method for Assessing Earthquake-Induced Soil Liquefaction Potential".
Elms and Richards, "Displacement Regulated Design of Gravity Retaining Walls".
Lai Cho Sim and Berill, "Shaking Table Tests on Model Retaining Walls".
Aggour and Brown, "Evaluation of Methods Used in the Determination of Dynamic Earth Pressure".
Sharpe, et al, "The Seismic Design of an Industrial Chimney with Rocking Base".
Paulay, "Developments in the Design of Ductile Reinforced Concrete Frames".
Mitchell, "Seismic Design of Timber Structures".
Nicholetti, Jhaveri, Emkin and Mesley, "Computer-Aided Structural Analysis and Design of the 37-storey Los Angeles Bonaventure Hotel".
Bentley and Zen, "The Seismic Zoning of Indonesia for Normal Building Construction".
Hatrick, "Seismic Design Criteria, Risks and Costs".
Kolston, "Relative Costs of Seismic Provisions for Buildings".
Hoshiya and Ogasawara, "Earthquake Risk Analysis of Transportation Networks and their Optimum Urgent Planning".
Lord and Zayed, "An Approach in Earthquake Risk Analysis and Loss Control".
Lensen, "Earthquake Forecasting, Public Policy and Earthquke Forecasting".
Clark and Glogau, "Ceilings and Partitions: The Seismic Hazard and Damage Problem and Some Practical Solutions".
Shibata and Okamura, "An Evaluation Method of System Failure of Industrial Facilities".
Upritchard, "The Seismic Restraint of Building Services: A Code of Practice".
Blakeley, Charleson, Hitchcock, Megget, Priestley, Sharpe and Skinner, "Report of the Societies Sub-Committee on Base-Isolated Structures".
Blakeley, Edmonds, Megget and Wood, "Cyclic Load Testing of Two Refined Full Size Reinforced Concrete Beam-Column Joints".
Priestley, Thorby, McLarin and Bridgeman, "Dynamic Performance of Brick Masonry Veneer Panels".
Heng, Priestley and Park, "Influence of Foundation Compliance on the Seismic Response of Bridge Piers".
Raper and Buchanan, B. W., "Mechanical Reinforcing Bar Splice Systems: Test Procedures and Seismic Design Requirements".
Townsend, "Inelastic Response of Interior R/C Connections with slab".
Rhoades, "Earthquake forecasting Probability Charts".
Park and Keong, "Tests on Structural Concrete Beam-Column Joints with Intermediate Column Bars".
Fenwick, "Behaviour of Reinforced Concrete Beams Under Cyclic Loading".
Hefford, Randal and Skinner, "The New Zealand Strong Motion Earthquake Recorder Network".
Binney, McNaughton and Sharpe, "Design of the ANZ Head Office Building, Wellington, New Zealand".
Buchanan, A. H., "Diagonal Beam Reinforcing for Ductile Frames in Multi-storey Buildings".
Cooney, "Structural Performance of Houses in Earthquakes".
Mathewson and Davey, "The Use of Precast Concrete Cross-Braced Panels as an Earthquake Resisting System".
Katayama, "Damage to lifeline systems in the City of Sendai Caused by the 1978 Miyagiken-Oki earthquake".
Iwasaki and Kawashima, "Seismic Analysis of a Highway Bridge Considering Soil-Structure Interaction Effects".
Iwasaki and Kawashima, "Damage to Civil Engineering Structures Due to the Near Izu-Ohshima Earthquake of January 14, 1978".
Asama, Shioi, Motoda and Mitsuie, "An Experimental Study on Liquefaction of Sandy Soils on a Cohesive Soil Layer".
Suggate, "Seismotectonics and Earthquake Risk Macrozoning in New Zealand".
Omote, Ohsaki, Kakimi and Matsuda, "A New Proposal for Estimating the Expected Maximum Ground Acceleration at the Site and for Evaluating the Design Earthquake Force When Constructing Important Buildings or Structures".
Omote, Miyake and Narahashi, "Estimations of the Earthquake Force Apparent in an Epicentral Area in the Case of Large Destructive Earthquakes".
Yoshikawa, Iwasaki, Tai and Matsuzaki, "Ground Motion Near Causative Fault of Kitatango-Earthquake of 1927".
Bentley, "Average Estimates of the Attenuation with Distance of 5% Damped Acceleration Response Spectra".
Berrill and Braithwaite, "Design Spectra for Two New Zealand Cities".
Taylor and Williams, "Foundation and Soil Interaction Foundations for Capacity Designed Structures".
Hangai and Homma, "A Simple Analytical Method for Up-lift of walled Structures".
Asama, Shioi, Okahara and Mitsuie, "Recent Earthquake Resistant Design Methods for Different Types of Foundation in Japan".
Kelly, "Floor Response of Multi-Storey Yielding Structures".
Megget, "Analysis and Design of a Base-Isolated Reinforced Concrete Frame Building".
A combined paper including aspects of the following: four abstracts;
Skinner, Tyler and Hodder, "Special Components to Increase Earthquake Resistance".
Tyler, "Dynamic Tests on PTFE Sliding Bearings".
Heine, "The Design and Construction of Steel Energy Absorbing Dampers".
Robinson and Tucker, "A Lead-Rubber Hysteretic Damper Suitable for Base Isolation".